U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Lepidium ostleri

Common Name:

Ostler's Peppergrass

Lead region:

Region 6 (Mountain-Prairie Region)

Information current as of:

04/01/2012

Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

___ New Candidate

_X_ Continuing Candidate

___ Candidate Removal

> ___ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status
>
> ___ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species
>
> ___ Range is no longer a U.S. territory
>
> ___ Insufficient information exists on biological vulnerability and threats to support listing
>
> ___ Taxon mistakenly included in past notice of review
>
> ___ Taxon does not meet the definition of "species"
>
> ___ Taxon believed to be extinct
>
> ___ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

Petition Information

___ Non-Petitioned

_X_ Petitioned - Date petition received: 07/30/2007

90-Day Positive:08/18/2009

12 Month Positive:02/23/2011

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing? **Yes**

Explanation of why precluded:

Higher priority listing actions, including court approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The Progress on Revising the Lists section of the current CNOR (http://endangered.fws.gov/) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories**: Utah
- **US Counties**: Beaver, UT
- **Countries**: United States

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: Utah
- **US Counties**: Beaver, UT
- **Countries**: United States

Land Ownership:

All known populations of *Lepidium ostleri* (Ostler’s peppergrass) occur on private lands in the southern San Francisco Mountains in Beaver County, Utah.

Lead Region Contact:

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Lead Field Office Contact:

UT ESFO, Bekee Hotze, 801-975-3330 x 146, bekee_hotze@fws.gov

Biological Information

Species Description:

Lepidium ostleri (Ostler's peppergrass) is a long-lived perennial herb in the mustard family (Brassicaceae). For the purposes of this document, we will refer to *Lepidium ostleri* as "Ostler's peppergrass." It grows in dense cushion-like tufts up to 2 inches (in.) (5 centimeters (cm)) tall (Welsh *et al.* 2008, p. 328). The grayish-green hairy leaves are 0.16 to 0.59 in. (4 to 15 millimeters (mm)) long, generally linear, and entire or with lobed basal leaves (Welsh *et al.* 2008, p. 328). Flowering stalks are approximately 0.39 in. (1 cm) long with 5 to 35 flowers that are white or have a purple tint (Figure 1; Welsh *et al.* 2008, p. 328).

Figure 1. Ostler's peppergrass. Photo: D. Roth, USFWS

Taxonomy:

Lepidium ostleri was first described in 1980 by Stan Welsh and Sherel Goodrich based on a collection by Stan Welsh and Matt Chatterly (Welsh and Goodrich 1980, entire; Kass 1992, p. 1). Ostler's peppergrass has not undergone any taxonomic revisions since it was originally described. We accept the current taxonomy and consider Ostler's peppergrass a listable entity under the ESA.

Habitat/Life History:

Lepidium ostleri is a narrow endemic restricted to soils derived from Ordovician limestone outcrops (Evenden 1998, p. 5). There are approximately 845 acres (ac) (342 hectares (ha)) of Ordovician limestone outcrops in the San Francisco Mountains (Miller 2010g, Appendix F). In addition, there are 719 ac (291 ha) of Cambrian dolomite substrates in the San Francisco Mountains; there is the potential for small "islands" of Ordovician limestone outcrops to occur within these substrates (Miller 2010g, Appendix F, p. 7). We do not know if there are other limiting factors associated with the limestone formations that restrict the habitat use and distribution of Ostler's peppergrass within this suitable habitat substrate, but Ostler's peppergrass occupies only a fraction of the available habitat.

Ordovician limestone is rare within a 50-mile (mi) (80-kilometer (km)) radius of the San Francisco Mountains (Miller 2010g, Appendix F). Cambrian dolomite substrates are present in the Wah Wah Mountains to the west of the San Francisco Mountains (Miller 2010g, Appendix F). However, there is no indication that additional populations of the species occur in these areas.

Lepidium ostleri is associated with pinion-juniper and sagebrush communities between 6,200 and 7,228 ft (1,890 and 2,203 m) in elevation. Plants are typically found on sparsely vegetated exposed slopes with *Ephedra* spp. (Mormon tea), *Gutierrezia sarothrae* (snakeweed), *Cercocarpus intricatus* (dwarf mountain-mahogany), and *Petradoria pumila* (rock goldenrod). Associated rare species include *Eriogonum soredium* (Frisco buckwheat) and *Trifolium friscanum* (Frisco clover).

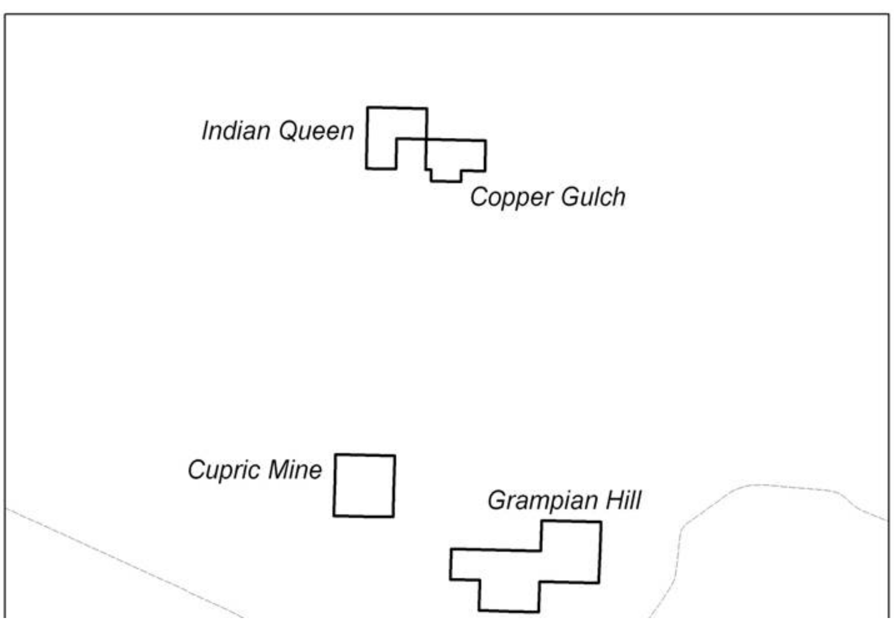
Flowering generally occurs from June to early July, followed by fruit set from July to August (Welsh *et al.* 2008, p. 328). No additional information is available on the life history of *Lepidium ostleri*.

Historical Range/Distribution:

Ostler's peppergrass is historically and currently known from four populations in the southern San Francisco Mountains in Beaver County, Utah (Kass 1992, p. 5; Evenden 1998, p. 5; Miller 2010g, p. 6; Roth 2010, pp. 1–2).

Current Range Distribution:

The total range of this species is less than 5 square miles (sq mi) (13 square kilometers (sq km)) and each of the four populations occupy relatively small areas ranging between 5 ac (2 ha) to 29 ac (12 ha) with localized high densities of plants (Figure 2; Evenden 1989, Appendix C; Miller 2010g, Appendix B). The total area occupied by Ostler's peppergrass is only 52 ac (21 ha), or just 6 percent, of the available Ordovician limestone outcrops. All four populations are on private lands in the southern San Francisco Mountains in Beaver County, Utah (Miller 2010g, p. 6; Roth 2010, pp. 1–2).



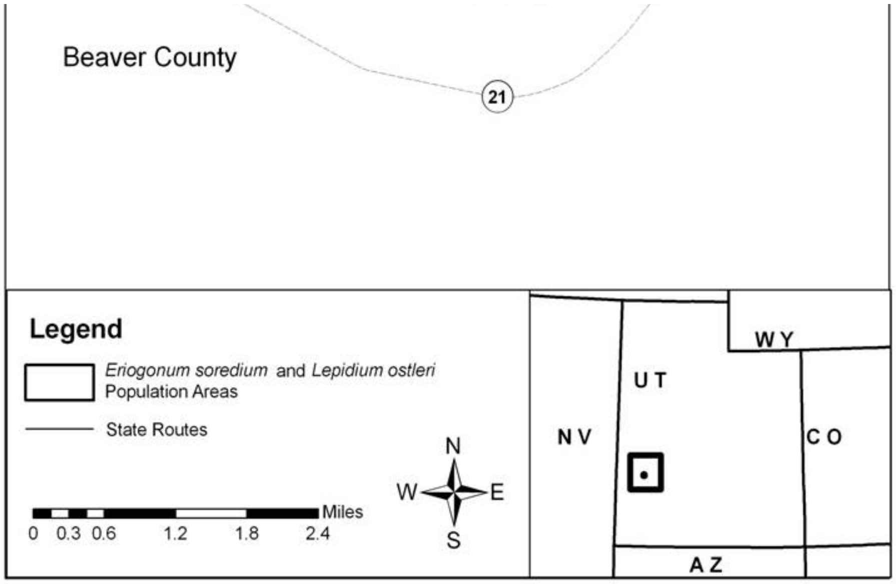


Figure 2. Ostler's peppergrass' range.

We are not aware of any additional populations. Surveys were conducted on Bureau of Land Management (BLM) lands adjacent to the known populations in 2010, and no plants or habitat were found (Miller 2010g, Appendix B and p. 6; Roth 2010, pp. 1–3); however these adjacent areas do not contain Ordovician Limestone, the substrate that supports Ostler's peppergrass (Miller 2010g, p. 6). Similarly, no additional populations of this species was found during surveys of the San Francisco Mountains and surrounding ranges (including the Wah Wah Mountains, Crystal Peak, the Confusion Range, and the Mountain Home Range) (Kass 1992, p. 5; Evenden 1998, p. 5; Miller 2010c, entire; Roth 2010, pp. 2–3).

Population Estimates/Status:

All known *Lepidium ostleri* populations are located on private lands (Miller 2010g, p. 6; Roth 2010, pp. 1–2). Their occurrence on these private lands hinders our ability to collect accurate long-term population counts or trend information because of access limitations. Populations were visited sporadically over the last couple of decades; however, we have no information on sampling methods used by individual surveyors. Common field techniques used to estimate population size tend to be highly subjective in the absence of actual population counts. Population estimates also may be skewed by how the species grows. The species grows in low, mound-forming clusters, making it difficult to distinguish individual plants—some observers may assume each cluster is one plant and other observers might apply a multiplier to each cluster to count them as multiple plants; therefore, using either of these methods would greatly skew the resulting population estimate. We believe these biases help explain the seemingly large fluctuations in numbers of plants observed during different surveys (see below). Ostler's peppergrass is a robust, long-lived perennial plant that is unlikely to exhibit such extreme population fluctuations (Garcia *et al.* 2008, pp. 260–261).

We lack demographic information, which is measured by studying the size, distribution, composition, and changes within a specified population over time. Rather, we have surveys that were done over time with varying degrees of effort. Accordingly, available population estimates range from a total of 700 individuals (Kass 1992, p. 8) to approximately 17,000 individuals in the 1990s (Evenden 1998, Appendix C). Currently, the total number of *Lepidium ostleri* plants is estimated at approximately 43,000 (Miller 2010a, pers. comm.; Miller 2010c, pp. 2–5; Roth 2010a, p. 4). However, due to the aforementioned survey inaccuracies, we are not able to determine accurate population estimates or trends for this species. In 2010, the species was documented at all four known populations (Miller 2010g, entire).

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Our February 23, 2011, final rule (76 FR 10166) evaluated multiple potential threats to *Lepidium ostleri*. Our discussion below is focused on the primary threats affecting the species, including habitat destruction and associated impacts from precious metal and gravel mining on private lands, and the invasion of nonnative species.

Mining

Mining activities occurred historically throughout the range of *Lepidium ostleri* and continue to impact the species. Mining activities can impact Ostler's peppergrass by removing habitat substrate, increasing erosion potential, fragmenting habitat through access road construction, degrading suitable habitat, and increasing invasive plant species (Brock and Green 2003, p. 15; BLM 2008a, pp. 448–449). Impacts to Ostler's peppergrass individuals include crushing and removing plants, reducing plant vigor, and reducing reproductive potential through increased dust deposits, reduced seedbank quantity and quality, and decreased pollinator availability and habitat (Brock and Green 2003, p. 15; BLM 2008a, pp. 448–449).

The San Francisco Mountains have an extensive history of precious metal mining activity (Evenden 1998, p. 3). All four of the known populations and much of the species' potential habitat were impacted by precious metal mining activities in the past, as evidenced by a high density of mine shafts, tailings, and old mining roads throughout the habitat of *Lepidium ostleri* (Table 1; Kass 1992, p. 10; Evenden 1998, p. 3; Roth 2010, p. 2).

The eastern part of the Grampian Hill population surrounds old mine shafts associated with the King David Mine, which is part of the historical Horn Silver Mine. The Horn Silver Mine was one of the largest silver mines in the country until it collapsed in 1885 (Murphy 1996, p. 1; Evenden 1998, p. 3). The Cupric Mine population is located immediately above a mine shaft associated with the Cupric Mine, a historical copper mine. Old mine shafts are located within 0.3 mi (0.5 km) of the Copper Gulch population; these mine shafts are associated with the Cactus Mine, also a historical copper mine. Two mine shafts are located within the Indian Queen population and three additional mine shafts are located immediately adjacent to this population. These mine shafts also are part of the historical Cactus Mine.

Table 1. Mining activities in Ostler's peppergrass' habitat.

Population	Historical Activity	Current Activity	Future Activity

Grampian Hill	silver, lead, copper, zinc (Horn Silver Mine)	None	silver, lead, copper, zinc, landscape gravel quarrying
Cupric Mine	silver, lead, copper, zinc, gravel quarrying (Cupric Mine)	gravel quarrying	silver, lead, copper, zinc, landscape gravel quarrying
Copper Gulch	silver, lead, copper, zinc, gravel quarrying (Cactus Mine)	gravel quarrying	silver, lead, copper, zinc, landscape gravel quarrying
Indian Queen	silver, lead, copper, zinc, gravel quarrying (Cactus Mine)	gravel quarrying	silver, lead, copper, zinc, landscape gravel quarrying

Large-scale precious metal mining ceased decades ago. However, all precious metal mining claims in the southern San Francisco Mountains are patented (a claim for which the Federal Government has passed its title to the claimant, making it private land) and continued occasional explorations for silver, zinc, and copper deposits are reported for the area (Bon and Gloyn 1998, p. 12; Franconia Minerals Corporation 2002, p. 1). In fact, in 1998 this area was one of the most active precious metal exploration areas in the state (Bon and Gloyn 1998, pp. 11–12). In addition, exploration activities were reinitiated at the Horn Silver Mine in 2002, confirming that extensive amounts of sphalerite (the major ore of zinc) remain in the mine (Franconia Minerals Corporation 2002, p. 1).

We expect the demand for silver and copper to increase in the future (Crigger 2010, pp. 1–2; Murdoch 2010, pp. 1–2). The price for silver nearly tripled over the last decade (Stoker 2010, p. 2). The market for silver is expected to grow in the future due to its high demand for industrial uses in solar panel construction, wood preservatives, and medical supplies (Ash 2010, p. 1). Since 2009, the value of copper increased more than 140 percent (Crigger 2010, pp. 1–2; Murdoch 2010, pp. 1–2). The market for copper, one of the world’s most widely used industrial metals, is expected to increase in the future due to demand for electrical wiring, plumbing, and car fabrication (Crigger 2010, pp. 1–2; Murdoch 2010, pp. 1–2). In Utah, precious metals accounted for approximately 14 percent of the total value of minerals produced in 2009 (up from 8 percent in 2008) (Utah GOPB 2010, pp. 195–196). Utah’s precious metal gross production value increased $221 million (57 percent) compared to 2008, due to increased production of both gold and silver (Utah GOPB 2010, p. 196). Because the San Francisco Mountains area was one of the most productive areas during the last large-scale precious metal mining efforts, it is reasonable to assume that it will become important again, particularly given the ongoing exploration activities at the mines.

Ostler’s peppergrass is endemic to soils derived from Ordovician limestone. In addition to precious metals, this formation is mined for crushed limestone. The limestone is removed from quarry sites and sold for marble landscaping gravel. Marble landscaping gravel quarries in Ostler’s peppergrass’ range are open-pit mines that result in the removal of the habitat substrate for these species. Four active limestone quarry sites occur within a couple hundred feet of three of the species’ populations—Cupric Mine, Copper Gulch, and Indian Queen populations (Table 2).

A limestone quarry is considered active from the time quarrying begins until the site is reclaimed. Generally, gravel pits are maintained below 5 ac (2 ha) of surface disturbance to avoid large mine status, which requires permitting (Munson 2010, pers. comm.). Hence, an area may contain many quarries at or below the 5 ac (2 ha) threshold, all of which may be considered active (Munson 2010, pers. comm.). A mine also may stay below 5 ac (2 ha) as long as previously disturbed areas at the quarry site are reclaimed prior to expanding quarrying operations (Munson 2010, pers. comm.). The Cupric Mine, Copper Gulch, and Indian Queen Ostler’s peppergrass populations all have small individual gravel pits—resulting in a lack of environmental analyses and potential mitigation opportunities (see Factor D, *Inadequacy of Existing Regulatory Mechanisms*).

As stated in the Current Range / Distribution section above, Ostler’s peppergrass occurs in a total of 52 ac

(21 ha), distributed in four populations. We estimate the quarries at three population sites (Cupric Mine, Copper Gulch, and Indian Queen) historically resulted in the loss of 26 ac (11 ha) of suitable habitat adjacent to currently known plant locations (Table 2; Darnall *et al.* 2010, entire). Based on habitat similarities and proximity, it is likely that the plant occupied the entire 26 ac (11 ha) that are now being quarried. There are 23 ac (9 ha) of remaining occupied habitat in the three populations (Table 2; Darnall *et al.* 2010, entire), but these areas are at risk of being impacted by the gravel pits. The only population not impacted by gravel pits—the Grampian Hill population—is 29 ac (12 ha) in size. Even so, the Grampian Hill population is only 1 mi (1.6 km) away from the nearest gravel pit and, as previously discussed, it is impacted by precious metal mining.

Table 2. Areas of surface disturbance associated with gravel mining in the vicinity of *Lepidium ostleri*.

Population	Occupied Area	Adjacent Surface Disturbance
Indian Queen	9 ac (3.6 ha)	14 ac (5.7 ha)
Copper Gulch	5 ac (2.0 ha)	5 ac (2.0 ha)
Cupric Mine	9 ac (3.6 ha)	7 ac (2.8 ha)
TOTAL	23 ac (9.2 ha)	26 ac (10.5 ha)

Quarrying is occurring in the immediate vicinity of the Cupric Mine population (Evenden 1998, p. 5; Robinson 2004, p. 8; Frates 2006, pers. comm.; Roth 2010, p. 2; Miller 2010d, pers. comm.; Munson 2010, pers. comm.); we anticipate this mining activity will continue to impact this population in the near future (Roth 2010, p. 2). The estimated area of occupied habitat of the Cupric Mine population in the vicinity of this gravel pit is 9 ac (4 ha) (Table 2; Darnall *et al.* 2010, entire), while gravel mining has resulted in surface disturbance of approximately 7 ac (3 ha) (Table 2; Darnall *et al.* 2010, entire). No quarrying activity was observed in the vicinity of the Copper Gulch and Indian Queen populations in 2010; however, the gravel pits are still considered active and thus additional gravel mining could occur at any time. For both of these populations (Copper Gulch and Indian Queen), adjacent surface disturbance is equal to or greater than the remaining occupied habitat (Table 2; Darnall *et al.* 2010, entire).

It is important to note that all of the active quarries are near or above the 5 ac (2 ha) regulatory limit. Thus, we anticipate that the operators will file for large mine permits, partially restore the disturbed areas to be below the 5 ac (2 ha) limit, or will begin new gravel pits (Munson 2010, pers. comm.). Under any of these scenarios, it is likely that the occupied habitat of *Lepidium ostleri* will be impacted, particularly given the ongoing need for limestone gravel in nearby communities, as described below.

Between 1995 and 2001, the production of building and landscaping stones in Utah jumped nearly 700 percent (Stark 2008, p. 1). Construction sand, gravel, and crushed stone production rank as the second most valuable commodity produced among industrial minerals in Utah (Bon and Krahulec 2009, p. 5). The use of landscape gravel will likely continue to increase in nearby Washington County, which is one of the fastest growing counties in the United States and Utah (U.S. Census Bureau 2010, entire; Utah GOPB 2010, p. 48). The Washington County population has doubled every 10 years since 1970. In 2009, there were 145,466 people estimated to live in Washington County (Utah GOPB 2010, p. 49). Over 700,000 people are expected to live in Washington County by 2050 (Utah GOPB 2008, entire). Based on the projected population growth for Washington County, we believe that the regional demand for landscape gravel will continue to increase in southwestern Utah in the foreseeable future.

Much of the rock quarried in Utah does not travel far because of the associated high cost of transport (Stark 2008, p. 1). The quarries of the southern San Francisco Mountains are the closest quarries providing crushed limestone for southwestern Utah, including Washington County (Mine Safety and Health Administration

2010, p. 1). In addition to regional distribution, crushed limestone quarried from the vicinity of the Copper Gulch, Indian Queen, and Cupric Mine populations is transported to a distribution center for the Home Depot in the nearby town of Milford, where it is packaged and shipped nationwide (Munson 2010, pers. comm.).

To summarize, mining throughout Ostler's peppergrass' range reduced available habitat and impacted the species' populations in the past (Table 1; Table 2). All four populations of Ostler's peppergrass co-occur with precious metal mining activities. Three of the four populations—the Cupric Mine, Copper Gulch, and Indian Queen populations—co-occur with active gravel mining pits. Available information suggests that all populations are likely to be impacted by precious metal and gravel mining in the foreseeable future based on mineral availability and market projections. Therefore, we determined that mining is a threat to Ostler's peppergrass.

Nonnative Invasive Species

The spread of nonnative invasive species is considered the second largest threat to imperiled plants in the United States (Wilcove *et al.* 1998, p. 608). Invasive plants—specifically exotic annuals—negatively affect native vegetation, including rare plants. One of the most substantial effects is the change in vegetation fuel properties that, in turn, alter fire frequency, intensity, extent, type, and seasonality (Menakis *et al.* 2003, pp. 282–283; Brooks *et al.* 2004, p. 677; McKenzie *et al.* 2004, p. 898). Shortened fire return intervals make it difficult for native plants to reestablish or compete with invasive plants (D'Antonio and Vitousek 1992, p. 73). Additionally, invasive plants can exclude native plants and alter pollinator behaviors (D'Antonio and Vitousek 1992, pp. 74–75; DiTomaso 2000, p. 257; Mooney and Cleland 2001, p. 5449; Levine *et al.* 2003, p. 776; Traveset and Richardson 2006, pp. 211–213). For example, *Bromus tectorum* outcompetes native species for soil nutrients and water (Melgoza et al. 1990, pp. 9–10; Aguirre and Johnson 1991, pp. 352–353).

Bromus tectorum (cheatgrass) is considered the most ubiquitous invasive species in the Intermountain West due to its ability to rapidly invade native dryland ecosystems and outcompete native species (Mack 1981, p. 145; Mack and Pyke, 1983, p. 88; Thill *et al.* 1984, p. 10). If already present in the vegetative community, cheatgrass increases in abundance after a wildfire, increasing the chance for more frequent fires (D'Antonio and Vitousek 1992, pp. 74–75). In addition, cheatgrass invades areas in response to surface disturbances (Hobbs 1989, pp. 389, 393, 395, 398; Rejmanek 1989, pp. 381–383; Hobbs and Huenneke 1992, pp. 324–325, 329, 330; Evans *et al.* 2001, p. 1308). Cheatgrass is likely to increase due to climate change (see Factor E) because invasive annuals increase biomass and seed production at elevated levels of carbon dioxide (Mayeux *et al.* 1994, p. 98; Smith *et al.* 2000, pp. 80–81; Ziska *et al.* 2005, p. 1328).

Cheatgrass is a dominant species on the lower slopes of the Grampian Hill population and is present in all populations of Ostler's peppergrass (Miller 2010g, p. 5; Roth 2010, p. 1). Surface disturbances can increase the occurrence and densities of cheatgrass. As previously described, increased mining activities and associated surface disturbances are expected to occur in the occupied habitat for Ostler's peppergrass (see Mining, above), providing conditions allowing cheatgrass to expand into and increase density within Ostler's peppergrass habitat.

In addition, invasions of annual, nonnative species, such as cheatgrass, are well documented to contribute to increased fire frequencies (Brooks and Pyke 2002, p. 5; Grace *et al.* 2002, p. 43; Brooks *et al.* 2003, pp. 4, 13, 15). The disturbance caused by increased fire frequencies creates favorable conditions for increased invasion by cheatgrass. The end result is a downward spiral where an increase in invasive species results in more fires, more fires create more disturbances, and more disturbances lead to increased invasive species densities. The risk of fire is expected to increase from 46 to 100 percent when the cover of cheatgrass increases from 12 to 45 percent or more (Link *et al.* 2006, p. 116). In the absence of exotic species, it is generally estimated that fire return intervals in xeric sagebrush communities range from 100 to 350 years (Baker 2006, p. 181). In some areas of the Great Basin (Snake River Plain), fire return intervals due to cheatgrass invasion are now between 3 and 5 years (Whisenant 1990, p. 4). Most plant species occurring within a sagebrush ecosystem are not expected to be adapted to frequent fires, as evidenced in the lack of evolutionary adaptations found in other shrub-dominated fire adapted ecosystems like chaparral (Baker, in press, p. 17).

In the absence of cheatgrass, Ostler's peppergrass grows in sparsely vegetated communities unlikely to carry fires (see Habitat / Life History section). Thus, the species are unlikely to be adapted to survive fires. As described in the Current Range / Distribution section, the total range of this species is less than 5 sq mi (13 sq km) and each of the four populations occupy relatively small areas ranging between 5 ac (2 ha) and 29 ac (12 ha) (Table 2). A rangeland fire could easily impact, or eliminate, one or all populations. Therefore, the potential expansion of invasive species and associated fire is a threat to the species, especially when considering the limited distribution of the species and the high potential of stochastic extinctions (as discussed in the *Small Population Size section* under Factor E below).

In summary, nonnative invasive species and fire are threats to the species. Cheatgrass occurs in all four Ostler's peppergrass populations. Given the ubiquitous nature of cheatgrass in the Intermountain West and its ability to rapidly invade dryland ecosystems (Mack 1981, p. 145, Mack and Pyke, 1983, p. 88, Thill *et al.* 1984, p. 10), we expect it to increase in the future in response to surface disturbances from increased mining activities and global climate change (see the Climate Change and Drought section under Factor E). An increase in cheatgrass is expected to increase the frequency of fires in Ostler's peppergrass's habitat, and Ostler's peppergrass is unlikely to survive increased wildfires due to its small population sizes. Therefore nonnative invasive species and associated wildfires constitute a threat to all populations of Ostler's peppergrass.

Summary of Factor A

Mining activities impacted Ostler's peppergrass habitat in the past and continue to be a threat to the species and its habitat throughout its range. All of the populations and the majority of habitat are located on private lands with an extensive history and recent successful exploration activities for precious metal mining. Three of the four populations are located in the immediate vicinity of gravel mining. Gravel mining is expected to continue and expand in the near future (Munson 2010, pers. comm.). Considering the small acreages of occupied habitat immediately adjacent to existing gravel pits, continued mining may result in the loss of these populations in the foreseeable future. We anticipate an increase in the demand for precious metals and landscape rock based on the economic outlook for these commodities and the lack of alternative sources for crushed limestone in southwestern Utah which will result in increased impacts to Ostler's peppergrass and its habitat.

Cheatgrass is documented to occur in all four populations of Ostler's peppergrass. The threat of fire caused by annual nonnative species invasions is exacerbated by mining activities and global climate change (see the Climate Change and Drought section under Factor E). The small population sizes and extremely limited distribution make this species especially vulnerable to stochastic extinction events, including localized mining activities and wildfires caused by increased invasions of nonnative species (see the Small Population Size section under Factor E, below).

Therefore, Ostler's peppergrass is threatened by the present or threatened destruction, modification, or curtailment of the species' habitat or range, now and in the foreseeable future, based on impacts from mining activities and nonnative invasive species.

B. Overutilization for commercial, recreational, scientific, or educational purposes:

Ostler's peppergrass is considered an attractive rock garden plant. Seeds are available commercially and they are harvested from wild populations (Alplains Seed Catalog 2010, p. 2). Plants are located on private lands, which may provide some protection from collectors because access is restricted on these private lands. Despite the attractiveness of the species to horticultural enthusiasts, we have no information indicating that collection in the wild is a threat to the species.

C. Disease or predation:

Disease and herbivory of the species are unknown. We do not have any information indicating that disease is impacting Ostler's peppergrass. We also do not have any information indicating herbivory is occurring from livestock, wildlife, or insects (Kass 1992, p. 9; Evenden 1998, entire; Miller 2010a, entire; Miller 2010b, entire; Miller 2010c, entire; Roth 2010, entire). Thus, we do not consider disease and predation to be threats to these species.

D. The inadequacy of existing regulatory mechanisms:

There are no endangered species laws protecting plants on private, State, or tribal lands in Utah. Ostler's peppergrass is listed as a bureau sensitive plant by the BLM. Should the species be located on BLM lands, limited policy-level protection by the BLM is afforded through the Special Status Species Management Policy Manual # 6840, which forms the basis for special status species management on BLM lands (BLM 2008b, entire).

Ostler's peppergrass is predominantly threatened by mining related activities (see Factor A). Over 90 percent of the species' known potential habitat and all of the known populations are located on lands with private, patented mining claims (Kass 1992, p. 9; Evenden 1998, p. 9; Roth 2010, pp. 1–2). Mineral mining is subject to the Utah Mined Land Reclamation Act of 1975, which includes mineral mining on State and private lands, including lands with patented mining claims (Utah Code Title 40, Chapter 8). The ESA applies to all surface activities associated with the exploration, development, and extraction of mineral deposits.

The Utah Mined Land Reclamation Act mandates the preparation of State environmental impact assessments for large mining operations, which are defined as mining operations which create more than 5 ac (2 ha) of surface disturbance (UDOGM 2010b, p. 1). The existing gravel mining activities within Ostler's peppergrass' range (see Factor A, Mining) are near or above the 5 ac (2 ha) regulatory threshold. Thus, we anticipate that the operators will file for large mine permits, partially restore the disturbed areas to be below the 5 ac (2 ha) limit, or will begin new gravel pits (Munson 2010, pers. comm.).

State environmental impact assessments must address, at a minimum, the potential effects on State and federally listed species (Baker 2010, pers. comm.). Ostler's peppergrass is not State listed but is on the BLM sensitive species list. If UDOGM is made aware of this rare species being impacted by mining activities, they could consider minimizing and mitigating impacts; however, there is no requirement to address species that are not federally listed in UDOGM's mine permitting process (Baker 2010, pers. comm.).

In summary, the existing regulatory mechanisms are not adequate to protect Ostler's peppergrass from becoming threatened or endangered by gravel mining on private lands. The active gravel pits are near or above the 5 ac (2 ha) threshold that would normally incur regulatory environmental impact assessments; however, no assessments are completed for these mines. Even if an environmental impact assessment is completed for any of the mines, the existing mining laws do not necessarily apply to BLM sensitive species: They recommend, and do not mandate, species protection or mitigation. Thus, the inadequacy of existing mechanisms to regulate mining activities on private lands is a threat to all populations of Ostler's peppergrass now and in the foreseeable future.

E. Other natural or manmade factors affecting its continued existence:

Natural and manmade threats to Ostler's peppergrass' survival include: (1) small population size, (2) climate change, and (3) drought.

Small Population Size

Small populations and species with limited distributions are vulnerable to relatively minor environmental disturbances (Given 1994, pp. 66–67). Small populations also are at an increased risk of extinction due to the potential for inbreeding depression, loss of genetic diversity, and lower sexual reproduction rates (Ellstrand and Elam 1993, entire; Wilcock and Neiland 2002, p. 275). Lower genetic diversity may, in turn, lead to even smaller populations by decreasing the species' ability to adapt, thereby increasing the probability of population extinction (Barrett and Kohn 1991, pp. 4, 28; Newman and Pilson 1997, p. 360).

As previously described (see the Current Range / Distribution section), the entire range of the species is located in an area of less than 5 sq mi (13 sq km). Within this range, each of the four individual populations' occupied habitat areas are very small, ranging from 5 ac (2 ha) to 29 ac (12 ha) (based on Miller 2010g, Appendix B). Ostler's peppergrass can be dominant in small areas of occupied habitat, containing thousands of individuals. However, the small areas of occupation and the narrow overall range of the species make it highly susceptible to stochastic extinction events and the effects of inbreeding depression. Despite the overall lack of information on the population ecology of Ostler's peppergrass, we know that small populations are at an increased risk of extinction due to the potential for inbreeding depression, loss of genetic diversity, and lower sexual reproduction rates (Ellstrand and Elam 1993, entire; Wilcock and Neiland 2002, p. 275).

Mining, or a single random event such as a wildfire (see Factor A), could extirpate an entire or substantial portion of a population given the small acreages of occupied habitat. Species with limited ranges and restricted habitat requirements also are more vulnerable to the effects of global climate change (see the Climate Change and Drought section below; IPCC 2002, p. 22; Jump and Penuelas 2005, p. 1016; Machinski *et al.* 2006, p. 226; Krause 2010, p. 79).

Overall, we consider small population size an intrinsic vulnerability to Ostler's peppergrass that may not rise to the level of a threat on its own. However, the small population sizes rise to the level of a threat because of the combined effects of small population sizes, limited distribution, and narrow overall range, compounded by the effects of global climate change (see below) and the potential for stochastic extinction events from mining activities or habitat degradation and alteration from invasive species (see Factor A). Therefore, small population size, in combination with mining, invasive species, and climate change, is a threat to the species now and in the foreseeable future.

Climate Change and Drought

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Climate change is likely to affect the long-term survival and distribution of native species, such as Ostler's peppergrass, through changes in temperature and precipitation. Hot extremes, heat waves, and heavy precipitation will increase in frequency, with the Southwest experiencing the greatest temperature increase in the continental United States (Karl *et al.* 2009, pp. 28, 129). Approximately 20 to 30 percent of plant and animal species are at increased risk of extinction if increases in global average temperature exceed 2.7 to 4.5 degrees Fahrenheit (°F) (1.5 to 2.5 degrees Celsius (°C)) (IPCC 2007, p. 48). In the southwestern United States, average temperatures increased approximately 1.5 °F (0.8 °C) compared to a 1960 to 1979 baseline

(Karl *et al.* 2009, p. 129). By the end of this century, temperatures are expected to warm a total of 4 to 10 °F (2 to 5 °C) in the Southwest (Karl *et al.* 2009, p. 129).

Annual mean precipitation levels are expected to decrease in western North America and especially the southwestern States by mid century (IPCC 2007, p. 8; Seager *et al.* 2007, p. 1181). The levels of aridity of recent drought conditions and perhaps those of the 1950s drought years will become the new climatology for the southwestern United States (Seager *et al.* 2007, p. 1181). Although droughts occur more frequently in areas with minimal precipitation, even a slight reduction from normal precipitation may lead to severe reductions in plant production. Therefore, the smallest change in environmental factors, especially precipitation, plays a decisive role in plant survival in arid regions (Herbel *et al*. 1972, p. 1084).

Atmospheric levels of carbon dioxide are expected to double before the end of the 21st century, which may increase the dominance of invasive grasses leading to increased fire frequency and severity across western North America (Brooks and Pyke 2002, p. 3; IPCC 2002, p. 32; Walther *et al.* 2002, p. 391). Elevated levels of carbon dioxide lead to increased invasive annual plant biomass, invasive seed production, and pest outbreaks (Smith *et al.* 2000, pp. 80–81; IPCC 2002, pp. 18, 32; Ziska *et al.* 2005, p. 1328) and will put additional stressors on rare plants already suffering from the effects of elevated temperatures and drought.

No population trend data are available for Ostler's peppergrass, but drought conditions led to a noticeable decline in survival, vigor, and reproductive output of other rare plants in the Southwest during the drought years of 2001 through 2004 (Anderton 2002, p. 1; Van Buren and Harper 2002, p. 3; Van Buren and Harper 2004, entire; Hughes 2005, entire; Clark and Clark 2007, p. 6; Roth 2008a, entire; Roth 2008b, pp. 3–4). Similar responses are anticipated to adversely affect the long-term persistence of Ostler's peppergrass.

Ostler's peppergrass has a limited distribution and populations are localized and small. In addition, these populations are restricted to very specific soil types. Global climate change exacerbates the risk of extinction for species that are already vulnerable due to low population numbers and restricted habitat requirements.

Predicted changes in climatic conditions include increases in temperature, decreases in rainfall, and increases in atmospheric carbon dioxide in the American Southwest (Walther *et al*. 2002, p. 389; IPCC 2007, p. 48; Karl *et al.* 2009, p. 129). Although we have no information on how Ostler's peppergrass will respond to effects related to climate change, persistent or prolonged drought conditions are likely to reduce the frequency and duration of flowering and germination events, lower the recruitment of individual plants, compromise the viability of populations, and impact pollinator availability (Tilman and El Haddi 1992, p. 263; Harrison 2001, p. 78).

The actual extent to which climate change itself will impact Ostler's peppergrass is unclear, mostly because we do not have long-term demographic information that would allow us to predict the species' responses to changes in environmental conditions, including prolonged drought. Any predictions at this point on how climate change would affect the species would be speculative. However, as previously described, the species is threatened by mining activities (see *Mining*, Factor A) which will likely result in the loss of large numbers of individuals and maybe even entire populations. Increased surface disturbances associated with mining activities also will likely increase the extent and densities of nonnative invasive species and with it the frequencies of fires (see *Nonnative Invasive Species section* under Factor A). Given the cumulative effects of the potential population reduction and habitat loss (of already small populations) associated with mining, invasive species, and fire, we are concerned about the impacts of future climate change to Ostler's peppergrass.

In summary, we find it difficult to analyze the potential effects of global climate change on Ostler's peppergrass in the absence of demographic trend data, which would allow us to analyze how they respond to climate change over time. However, because of the threats of mining, nonnative species, and small population size, the cumulative effects of climate change may be of concern for these species in the future. At this time, we believe that the state of knowledge concerning the localized effects of climate change is too speculative to determine whether climate change is a threat to these species in the foreseeable future. However, we will continue to assess the potential of climate change to threaten the species as better scientific information becomes available.

Summary of Factor E

Ostler’s peppergrass has a highly restricted distribution and exists in four populations scattered over an area that is less than 5 sq mi (13 sq km). Individual populations occupy very small areas with large densities of plants. Even in the absence of information on genetic diversity, inbreeding depression, and reproductive effort, we believe a random stochastic event could impact a significant portion of a population. Small populations that are restricted by habitat requirements also are more vulnerable to the effects of climate change, such as prolonged droughts and increased fire frequencies.

While naturally occurring droughts are not likely to impact the long-term persistence of the species, an increase in periodic prolonged droughts due to climate change could impact the species across their entire range in the future. Global climate change, particularly when assessed cumulatively with small population sizes and threats from mining activities, could increase the density of invasive annual plants, which are already present in Ostler’s peppergrass’ habitat (see Factor A). Increased nonnative species in Ostler’s peppergrass’ habitat can increase fire frequency and severity. Because Ostler’s peppergrass is not likely adapted to persist through fires, wildfires can have a significant impact on these small populations.

Although small population size and climate change make the species intrinsically more vulnerable, we are uncertain whether they would rise to the level of threat by themselves. However, when combined with the threats listed under Factor A (*Mining* and *Nonnative Invasive Species*), small population size is likely to rise to the level of threat in the foreseeable future. At this time, we are uncertain of the degree to which climate change constitutes a threat to the species.

Conservation Measures Planned or Implemented :

In 2010, we worked with BLM to collect data that has contributed to our knowledge of Ostler’s peppergrass’ current status. We now have a better understanding of the relative importance of the various factors implicated in the species’ extinction risk. The BLM is working with the University of Southern Utah to create a habitat model for Ostler’s peppergrass and conduct surveys in areas identified by the model as potential habitat (Ponterolo 2012, pers. comm.). Results may locate additional populations on BLM lands and provide us with a better understanding of the species’ distribution, abundance, and threats. The Nature Conservancy of Utah is initiating communication with the landowners at our known occupied sites to establish conservation measures, including the potential for conservation easements for the known populations on private lands (York 2012, pers. comm.).

Summary of Threats :

The primary threat to the species is habitat destruction from precious metal and gravel mining on private lands (Factor A). All populations are located in the vicinity of historical precious metal mining activities. Ongoing exploration activities show the potential for continued mining activities in the foreseeable future. Three of the four populations are in the immediate vicinity of limestone quarries, all of which are considered active. We expect an increase in precious metal and limestone mining at these locations in the foreseeable future, with associated loss and fragmentation of Ostler’s peppergrass populations.

Cheatgrass occurs within all four Ostler’s peppergrass populations. It is a highly invasive nonnative species that spreads quickly in response to surface disturbances such as mining. As previously discussed, this species occurs in the immediate vicinity of precious metal and limestone mines—mines inherently cause surface disturbances from excavation activities and the construction of roads and other infrastructure. Global climate change is expected to increase drought conditions in the Southwest and increase the spread of nonnative invasive species. The biggest concern associated with the increase in invasive species is the threat of increased wildfire (Factor A), particularly when considering the small population sizes and small occupied habitat area associated with this species.

The magnitude of the biological threats posed by the species’ small population size and limited range is not well understood due to the lack of information available on Ostler’s peppergrass’ ecology. Future studies may provide us with a more thorough understanding of threats posed by pollinator limitation, inbreeding depression, and the potential lack of genetic diversity over the species’ range. However, the small areas of occupied habitat make the species highly vulnerable to habitat destruction through mining-related activities as well as random extinction events, including invasive species (and the inherent risk of increased fires) and the potential future effects of global climate change (Factor E).

The existing regulatory mechanisms are not adequate to protect Ostler’s peppergrass from the primary threat of mining, particularly because the species occurs entirely on private lands. The inadequacy of regulatory mechanisms (Factor D) on private land, combined with the economic and commercial value of the limestone and precious metals, poses a serious threat to Ostler’s peppergrass’ continued existence. Ongoing mining in Ostler’s peppergrass’ habitat has the potential to extirpate one of the four populations in the near future; all populations have the potential to be extirpated by mining-related activities in the foreseeable future (Factor A; Table 1).

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

- Determine habitat suitability on Federal lands and survey for additional populations.
- Pursue habitat protection for existing populations on private lands through land purchases or exchanges, conservation easements, and candidate conservation agreements.

Priority Table

Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/Population	6
Moderate to Low	**Imminent**	Monotypic genus	7
		Species	**8**
		Subspecies/Population	9
	Non-Imminent	Monotype genus	10
		Species	11
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

Magnitude:

Moderate. We consider threats that Ostler's peppergrass faces to be moderate in magnitude because the major threats (mining, nonnative species, small population size, climate change, and inadequacy of existing regulatory mechanisms), while serious and occurring rangewide, do not collectively rise to the level of high magnitude. For example, active mining is currently impacting only one of the four populations.

The magnitude of Factor A is considered moderate because although we think that all populations have been impacted by mining in the past and three of the four populations occur in the immediate vicinity of gravel pits, mining activities are currently ongoing in one of these gravel pits. Ongoing mining in the habitat of Ostler's peppergrass is expected to increase the density of cheatgrass, thereby facilitating the spread of fire. Cheatgrass is currently documented in all populations.

We considered the magnitude of Factor D high. All populations are located on private lands with patented mining claims. Existing regulatory mechanisms do not adequately protect Ostler's peppergrass from the impacts of mining on private lands. Although only one population is currently impacted by gravel mining, all populations have the potential to be impacted by gravel and precious metal mining in the future.

We consider the magnitude of Factor E moderate because although small population size and climate change make the species intrinsically more vulnerable, we are uncertain of whether they would rise to the level of threat by themselves. However, when collectively analyzed with the threats listed under Factor A, they may rise to the level of threat in the foreseeable future. Although we are uncertain about the direct impacts of global climate change on Ostler's peppergrass, we expect the species to respond negatively to changed environmental conditions and drought, primarily from an increase in nonnative invasive species and wildfire (see Factor A). The threats of nonnative invasive species and wildfire could result in the extirpation of all populations, especially because the populations are small in size.

Imminence :

Imminent. We consider all of the threats to be imminent because we have information that the threats are identifiable and that the species is currently facing them across its entire range. These actual, identifiable threats are covered in greater detail in Factors A, D, and E. The majority of threats are ongoing and therefore imminent, although gravel mining is currently impacting only one of the populations. In addition to their current existence, we expect these threats to continue and likely intensify in the foreseeable future.

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

__No__ Is Emergency Listing Warranted?

We determined that issuing an emergency regulation temporarily listing the species is not warranted at this time because there is no emergency posing a significant risk to the well-being of Ostler's peppergrass. We do not believe that any of the potential threats are of such great immediacy and severity that would threaten all of the known populations with the imminent risk of extinction. However, if at any time we determine that issuing an emergency regulation temporarily listing Ostler's peppergrass is warranted, we will initiate emergency listing at that time.

Description of Monitoring:

We are coordinating with the BLM Cedar City Field Office on the progress of the habitat model and anticipated surveys of potential habitat. We are also coordinating with the Nature Conservancy to pursue landowner contact and open a dialogue on the conservation of the species. No demographic or threats monitoring of existing populations is currently underway because all populations are located on private lands.

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

Utah

Indicate which State(s) did not provide any information or comment:

none

State Coordination:

Ostler's peppergrass is endemic to Utah. The BLM Cedar City Field Office in Utah provided information and comments on this assessment. No new information about the status of this species was available from the Utah Natural Heritage Program (UNHP) for this review. The UNHP actively tracks the status of this species and we will incorporate any updates or new information gathered in future assessments.

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Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:  05/31/2012
Date

Concur: 11/06/2012
Date

Did not concur: ______________________ ______________
Date

Director's Remarks: